REMARKS

This communication is a full and timely response to the non-final Office Action dated August 30, 2011. Claims 1, 3-6, 8, and 9 remain pending, where claims 10 and 11 were previously canceled. By this communication, claims 2 and 7 are canceled without prejudice or disclaimer of the underlying subject matter, and claims 1, 3-6, 8, and 9 are amended. Support for the amended subject matter can be found, for example, on page 8 lines 3-17 of the disclosure.

Claim Objections

In numbered paragraph 1 on page 2 of the Office Action, claims 7 and 8 are objected to for alleged informalities. Applicant's claim amendment renders this rejection moot, such that withdrawal of the same is appropriate

Rejections under 35 U.S.C. §103

In numbered paragraph 3 on page 3 of the Office Action, claims 1, 2, and 5 are rejected under 35 U.S.C. §103(a) for alleged unpatentability by Admitted Prior Art of *Williams* (U.S. Patent Publication No. 2008/0310426), and further in view of *Rui et al.* (US 2004/0220769). Applicant respectfully traverses this rejection.

As provided in Figs 1-5, exemplary methods are directed to the efficient decentralization of a particle filter. The method is achieved through a compact representation of a particle population. Each sensor node sends its tracks to neighboring nodes. The neighboring nodes update their respective tracks using the new information by dividing the local track PDF by the incoming track. The neighboring node then sends out its own tracks. A local particle population is used to generate a Gaussian mixture approximation. The local and incoming PDFs are

evaluated at each particle position, divided, and applied as a weight to the particles.

At each node, the particle population is updated with new information from another

node by weighting and resampling the particles. The weighting includes dividing a

distribution of the incoming Gaussian kernels by a distribution of the current

Gaussian kernels at the node.

Independent claims 1 and 5 encompass the foregoing features. In particular,

claim 1 recites the following:

> A method for estimating a system state that is applied in a network comprising a plurality of nodes, each node having means for receiving and sending information and means for processing information, and each node being connected to selected other nodes of the network, the method comprising, at each node:
> (i) maintaining a set of particles and associated weights, which represent an estimate of the system state,
> (ii) representing the estimated system state as a mixture of Gaussian distributions, and communicating said mixture to neighbouring nodes, and
> (iii) in response to receiving said mixture from a neighbouring node, updating the estimate of the system state that is maintained at the node by resampling the particles to provide new weights for each particle, wherein each new weight includes said mixture of Gaussian distributions received from a neighbouring node divided by said mixture of Gaussian distributions formed from the existing particle set in the node.

Claim 5 recites:

> A network for estimating a system state, the network comprising a plurality of nodes, each node having means for receiving and sending information and means for processing information, and each node being connected to selected other nodes of the network, each node including:
> particle filter means for maintaining a set of particles and associated weights, which represent an estimate of the system state, and means for updating the set when new information is available,
> means for representing the estimating system state as a mixture of Gaussian distributions, and means for communicating said mixture to neighbouring nodes,
> said means for updating, being responsive to receiving said mixture from a neighbouring node, for updating its estimate of the system state by computing new weights for

each particle using a resampling operation, wherein each new weight includes said mixture of Gaussian distributions communicated to the node divided by said mixture of Gaussian distributions representing the existing particle set at said node.

The combination of Applicant's Alleged Admitted Prior Art (AAPA), and *Rui* fail to disclose or suggest the features recited in Applicant's claims.

In describing the state of the art at the time the instant application was filed, the disclosure describes a known particle filter algorithm as including the following steps:

1. A set of particles are maintained that are candidate representatives of a system state. A weight is assigned to each particle, and an estimate of the state is obtained by the weighted sum of the particles (a non-analytic probability distribution function (pdf)).

2. A recursive operation is carried out that has two phases: prediction and update.

3. For prediction, at time t=k, the pdf is known at the previous time instant t=k−1. A system model is used to predict the state at time t=k.

4. For update, at time t=k, a measurement of the system becomes available, which is used to update the pdf that was calculated in the prediction phase. During update, the particles may be resampled to remove particles with small weight.

5. Return to 3.

The disclosure also provides that algorithms for solving problems over a network can be solved using a decentralized approach.

The Examiner acknowledges that *AAPA* fails to disclose or suggest representing the estimated system state as a mixture of Gaussian distributions, and relies on *Rui* in an effort to remedy this deficiency.

Rui discloses a system and process for tracking an object state over time using particle filter sensor fusion and a plurality of logical sensor modules (Abstract). When the object states of the logical sensors have been estimated in the form of

Gaussian distributions at each respective node, they are input into a fuser module. The fuser module combines the estimates to form a proposal function. In computing a reliability factor, the fuser uses the last computed reliability factor associated with each logical sensor in the next iteration to weight the estimate distribution generated by that sensor as part of combining the object state estimate distributions.

Nothing in *AAPA* or *Rui* discloses or suggest a feature in which estimates are updated by dividing the mixture of Gaussian distributions received from a neighboring node by a mixture of Gaussian distributions formed from the existing particle set in the node, as is variously recited in claims 1 and 5. In particular, while these documents may refer to updating the estimates, there is no specific discussion of performing an update in the manner recited in the claims. For at least these reasons, claims 1 and 5 are distinguishable over the applied art of record and withdrawal of this rejection is hereby requested.

In numbered paragraph 4 on page 5 of the Office Action, claims 3 and 8-9 are rejected under 35 U.S.C. §103(a) for alleged unpatentability by *AAPA* and *Rui* and further in view of *Mookerjee et al* (U.S. Patent No. 7,180,443); in numbered paragraph 5 on page 7 of the Office Action, claims 4 and 6 are rejected under 35 U.S.C. §103(a) for alleged unpatentability by *AAPA* in view of *Rui* and *Behroozi* (U.S. Patent Publication No. 2005/0226179); and in numbered paragraph 6 on page 7 of the Office Action, claim 7 is rejected under 35 U.S.C. §103(a) for alleged unpatentability by *AAPA* in view of *Rui* and *Behroozi.* Applicants respectfully traverse these rejections.

Each of claims 3, 4, 6, 8, and 9 depend from one of claims 1 and 5, where applicable. By virtue of these respective dependencies and because of the

additional features recited therein, respectively, Applicant submits that these claims are distinguishable and otherwise allowable over the prior art of record. Furthermore, none of the secondary prior art documents discloses or suggests updating estimates by dividing the mixture of Gaussian distributions received from a neighboring node by a mixture of Gaussian distributions formed from the existing particle set in the node, as is variously recited in claims 1 and 5. Therefore, a *prima facie* case of obviousness has not been established and withdrawal of this rejection is deemed appropriate.

CONCLUSION

Based on the foregoing amendments and remarks, claims 1, 3-6, 8, and 9 are allowable and this application is in condition for allowance. In the event, the Examiner has any further concerns preventing allowance of the claims and/or application, the same is invited to contact Applicant's representative identified below.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.20(d) and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date: <u>October 12, 2011</u>   By: ___<u>/Shawn B. Cage/</u>___
Shawn B. Cage
Registration No. 51522

Customer No. 21839
703 836 6620